

Translating farmers' objectives and preferences into scenario sets for the design and assessment of (smallholder) crop-livestock systems

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Abstract

Dairy farmers of the South use a diversity of feed resources, cultivated or not, together with crop residues and different types and amounts of supplements. Feed requirements may be met by purchasing concentrated dairy meals, allocating land to fodder production or making use of the natural vegetation in communally or privately owned grazing lands. All these strategies entail different degrees of economic and environmental risks and impacts, depending on the nature of the biophysical resource base, the livelihood strategy and market orientation of the household, and the broader socio-economic context. Livelihood strategies are driven by the objectives and preferences of the decision-maker, his or her attitudes towards risks and the resulting resource allocation pattern. We examined examples from smallholder crop-livestock systems in Latin America and Africa where competing uses for financial, land and labour resources make it difficult to find an optimum design (e.g., through allocation of land to crop vs. fodder production) of the crop-livestock system. We propose the use of companion modeling to assist co-innovation processes thereby formalizing opportunities and constraints for the production systems and encompassing the decision maker objectives and preferences. This methodology is being used in two case studies in the highlands of Central Kenya and in Central Mexico. Objectives and preferences were derived through participatory work. These were used together with a dynamic simulation tool to analyse plausible pathways for intensification. The modelling tool (NUANCES-FARMSIM) includes relatively simple crop-soil, livestock, and organic resource management sub-models, a labour and a cash balance. The analytical tool includes a decision making module, equipped with a MGLP (multiple goal linear programming) model which combines stepwise the results from the dynamic simulations with prices for inputs and outputs, and objectives and preferences, making the decision making dynamic at a different temporal scale. The results of the modelling exercise are presented to the farmers and other stakeholders to stimulate discussions on alternative management of their systems. Lessons learnt from the companion modelling exercises show that most dairy farmers making non-optimal tactical decisions and are willing to stay in the sector at lower profit levels and the model selects using the objectives and preferences reported by the farmers. According to the simulations, strategic decisions such as planning replacements and balancing the herd structure results in the largest biophysical productivity and profit at a large range of prices of inputs and outputs.